

REMARKS

Claims 1-12 were pending in the present application. By virtue of this response claims 1, 4, and 12 have been amended, claim 2 cancelled, and claim 13 has been added. Claims 8-11 have been withdrawn from consideration. Accordingly, claims 1, 3-7, 12, and 13 are currently under consideration. Support for the amendments to claims 1, 4, and 12 and newly added claim 13 may be found throughout the present application, for example, page 31, line 8 to page 32, line 17. Amendment and cancellation of certain claims is not to be construed as a dedication to the public of any of the subject matter of the claims as previously presented.

I. Restriction Requirement

Applicants affirm the election of product claims 1-7 and 12. New claim 13 depends from claim 1 and is therefore properly included with product claims 1-7 and 12.

II. Rejections under 35 U.S.C. §112

Claim 2 stands objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim. Claim 2 has been cancelled and the rejection is now moot.

Claim 4 is objected to because the word “lawer” should read --layer--, and claim 12 is objected to because the words “con pound” should read --compound--. Appropriate corrections have been made in the above amendments.

III. Rejections under 35 U.S.C. §103(a)

Claims 1-7 and 12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kimura et al., U.S. Patent No. 6,201,823 (hereinafter “Kimura”) in combination with Zauner et al. (hereinafter “Zauner”).

Applicants submit that the Examiner has failed to establish *prima facie* case of obviousness because there is no identified suggestion, motivation, or teaching for the combination of Kimura and Zauner to meet the features of claim 1, and further, the combination of Kimura and Zauner fail to disclose or suggest the features of claim 1.

To establish a *prima facie* case of obviousness there must be some suggestion or motivation in the prior art to combine the reference teachings. MPEP §§ 2142, 2143.01. In this instance the Examiner has not identified any teaching, suggestion, or motivation found in the prior art for replacing the sapphire substrate of Kimura with the GaN layer of Zauner as stated on page 4 of the Office Action (paper No. 20). The Examiner states, “it would have been obvious to one of ordinary skill in the art to replace sapphire substrate with GaN substrate... for the benefit of obtaining smoother layers...,” but has not identified any teaching in the prior art for modifying Kimura to include a GaN substrate. Obviousness findings without a specific finding of a suggestion, motivation, or teaching in the prior art to replace the sapphire substrate with a GaN substrate do not carry the Examiner’s burden to establish a *prima facie* case of obviousness and the rejection should be withdrawn.

Furthermore, even if a teaching, suggestion, or motivation exists in the prior art to combine the teachings of Kimura and Zauner, Applicants respectively submit that the combination does not fairly teach, suggest, or motivate one of ordinary skill in the art to modify the sapphire substrate of Kimura with the GaN layer of Zauner to result in a device having the features of claim 1. In particular, the combination of Kimura and Zauner fails to disclose or suggest a nitride compound semiconductor light emitting device including “a GaN substrate having a crystal orientation which is tilted away from its main plane orientation of a <0001> direction by an angle which is equal to or greater than about 0.05 and which is equal to or less than about 2,” as recited by amended claim 1.

Applicants note that the nitride semiconductor light-emitting device recited in claim 1 includes a GaN substrate having a crystal orientation that is slightly inclined within a range of 0.05°

to 2° against a <0001> plane. This feature varies the growing condition of the nitride semiconductor provided on the GaN substrate, thereby reducing In transportation and In coagulation with the active layer. Also, the smoothness or evenness of the active layer, which is a semiconductor multilayer structure of a well layer and a blocking layer having a period of several nm, is formed evenly on a microscopic scale, i.e., an amount less than the thickness of each of the well layer and the blocking layer. This feature improves the quality of the active layer and improves the properties of the device. Also, upon reducing In transportation reaching a p-type layer by means of slightly tilting the surface of the GaN substrate, a p-type conduction can be realized without the necessity of p-type annealing. In order to obtain these effects, the surface of the GaN substrate, which is a <0001> plane of which the main plane is ended by Ga, is tilted by a small angle such as 0.05-2°, excluding 0°. If a tilting angle is outside of this range, for instance the angle is the same as the <0001> plane, it may cause a surface roughness larger than the thickness of a period of the active layer, and does not improve the property of the device. Also, if the main plane is a <000-1> of the cited reference and has different polarity from that of <0001> plane of the present claims, the mode of crystal growth is varied, and it cannot obtain an evenness which is desired to manufacture a multi well active layer having a large weight amount.

In contrast to claim 1, Kimura discloses a semiconductor device formed on a sapphire substrate wherein a current block layer within a structure including a nitride semiconductor on the sapphire substrate is provided by selective growing at the time of forming the structure. The stripe marks are adopted to enable the selective growing of the current block layer. Kimura, col. 4, lines 39-47. With this arrangement of selective growing, however, at least one portion of the growing layer is formed with unevenness, and bends along the length of the selected growing layer.

Further, Kimura discloses a device having a current block layer by means of selective growing even where an angle of the substrate surface is largely tilted in the range of 0 to 10 degrees against the (0001)-face. Kimura, col. 6, lines 1-15. In light of this disclosure the purpose of tilting

the substrate surface by a large angle of 0 to 10 degrees is apparently to form a current block layer, or the employment of selected growing thereof. Kimura also discloses an angle in a range of -5 degrees to +5 degrees to a [11-20] direction or a [1-100] direction, which is an angle to rotate the stripe marks within a plane of a substrate surface, but Kimura fails to disclose what direction an angle of the substrate surface is tilted against a (0001) plane thereof. Kimura, col. 6, lines 13-29.

The features of claim 1 improve the quality of an active layer by reducing In condensation and inversion within the active layer. This is upon changing the growth condition of a nitride semiconductor to be grown on the surface of a GaN substrate which is slightly tilted in the extremely small range of 0.05 to 2 degrees against a (0001) plane. This provides the result that an active layer constituting an integral layer construction having a several nm period is formed evenly, to an extent less than an individual layer thickness of a well type layer and a barrier layer. Normally, a nitride compound semiconductor grown on a sapphire substrate causes concave and convex stripes formed on its surface which can be recognized by the human eye. The average roughness of the surface may reach several tens of angstroms to several hundreds of angstroms. Accordingly, as long as a sapphire substrate is employed, the concave convex stripes from the surface of the sapphire substrate cannot be completely eliminated. Accordingly, the device of claim 1 is markedly different from the disclosure of Kimura.

The addition of Zauner fails to cure the deficiencies of Kimura and does not fairly suggest modifying the device of Kimura to meet the features of claim 1. Zauner discloses an arrangement of homo-epitaxial growth on a single crystal GaN substrate, the epitaxial growth being conducted in a (0001) direction of the substrate surface. Zauner includes at least the following defects in comparison with the features of the present claims. First, because GaN is a crystal having a polarity different from Si, the physical properties of GaN are different depending on the plane orientation to be used as the substrate, and on its crystal growth. The growing mode is completely different from that of Si. Second, in a homoepitaxial film formed on the <000-1> plane substrate as disclosed in

Zauner, hillocks of large size are generated which are recognizable by the human eye. Also, the reference Zauner attempts to reduce the numbers of hillocks, which is different from the smoothness or evenness attainable by the present claims. Third, the size of the hillocks disclosed in Zauner are 10-50 μ m, and it is speculated that the growing layer thickness necessary to eliminate such large hillocks is beyond several tens of μ m, which is extremely large in comparison with 1 μ m which is a minimum distance between the active layer and substrate as presently claimed. Fourth, Zauner discloses a tilting of the substrate which includes zero degree, which is different from the features presently claimed. Accordingly, the combination of Kimura and Zauner fail to disclose or suggest the features of claim 1, and one skilled in the art would not be motivated to combine the teachings of Kimura and Zauner or modify the teachings of Kimura and Zauner to meet the features of the claim 1.

Therefore, in light of the above remarks and amendments, the applied references fail to disclose or suggest all of the features of the semiconductor device of claims 1-7, 12, and 13. Further, there is no teaching, suggestion, or motivation to combine and modify the references to meet the limitations of claims 1-7, 12, and 13. Accordingly, claims 1-7, 12, and 13 are allowable over Kimura and Zauner alone or in combination and the rejection should be withdrawn.

CONCLUSION

Applicant has, by way of the amendments and remarks presented herein, made a sincere effort to overcome rejections and address all issues that were raised in the outstanding Office Action. Accordingly, reconsideration and allowance of the pending claims are respectfully requested. If it is determined that a telephone conversation would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, Applicant(s) petition(s) for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing docket no. **(299002051800)**. However, the Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

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Respectfully submitted,

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